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Chuah et al.

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(54) **DYNAMIC CODE ALLOCATION FOR DOWNLINK SHARED CHANNELS**

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(22) Filed: **Mar. 16, 1999**

(51) **Int. Cl.**[7] **H04B 1/69**; H04B 7/216; H04L 23/00

(52) **U.S. Cl.** **375/140**; 375/146; 375/147; 375/377; 370/335

(58) **Field of Search** 375/130, 140, 375/141, 146, 377, 147; 370/203, 208, 342, 335, 329

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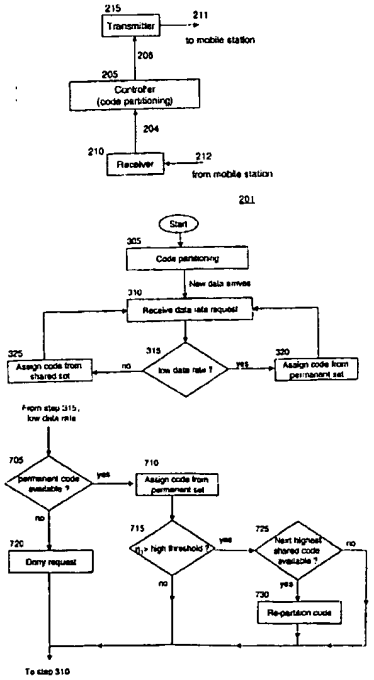
Primary Examiner—Tesfaldet Bocure

(57) **ABSTRACT**

In a Universal Mobile Telecommunications System (UMTS) based wireless system, a channelization code-tree is partitioned into two sets: a permanent set and shared a shared set. Those codes in the permanent set are assigned to low data rate users for the duration of a session, or connection. Those codes in the shared set are assigned to high data rate users on a frame-by-frame basis using a downlink shared (DSCH) channel. The partition boundary between the permanent set and the shared set can be dynamically shifted based on traffic conditions.

24 Claims, 7 Drawing Sheets



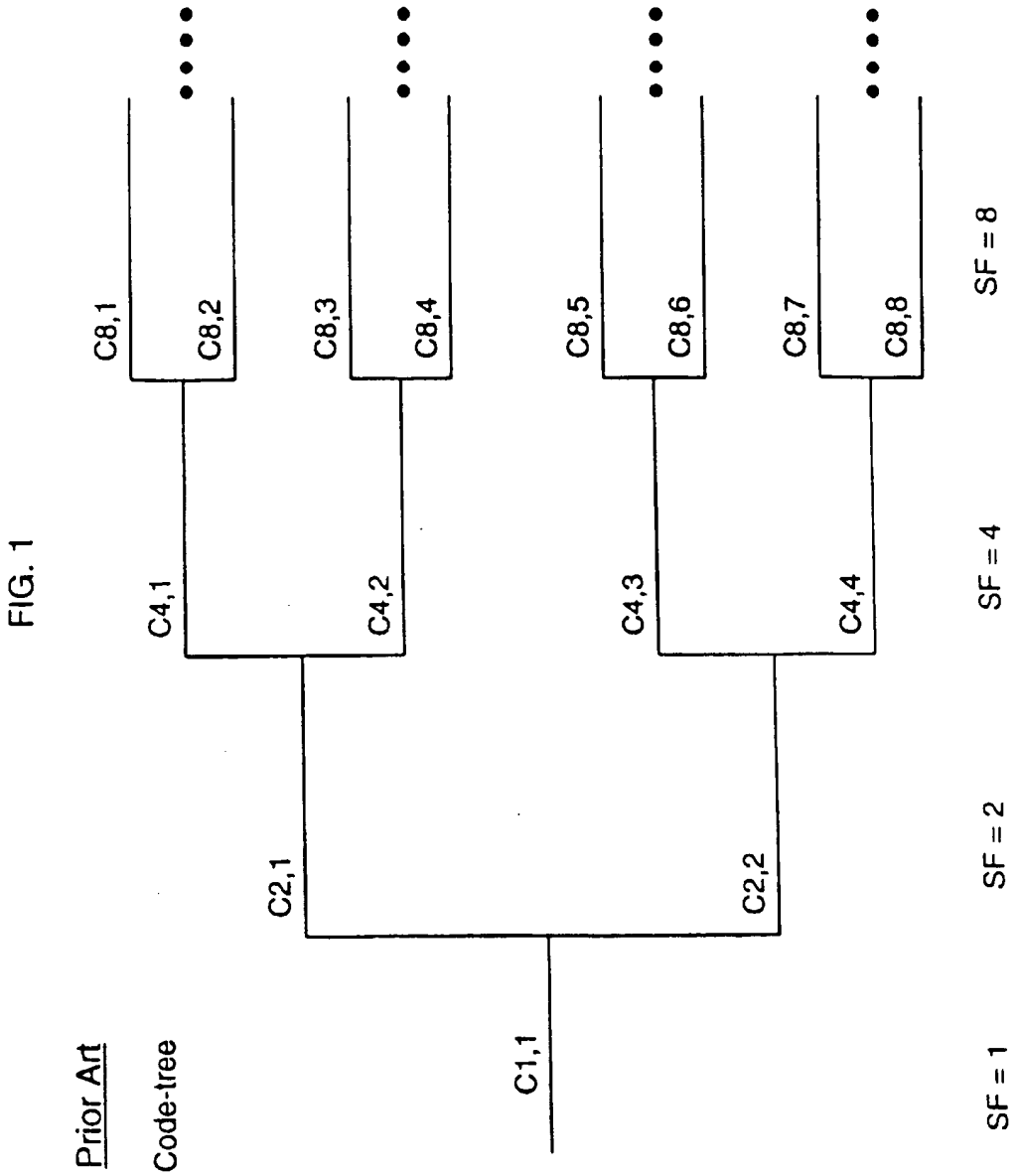
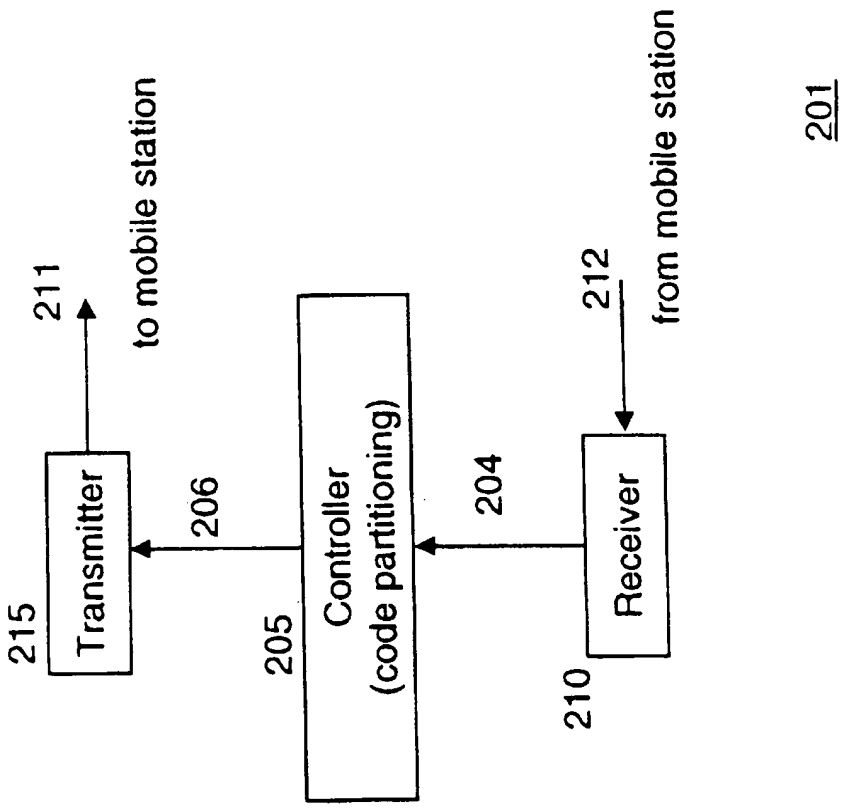

C8,1
C8,2
C8,3
C8,4
C8,5
C8,6
C8,7
C8,8
C4,1
C4,2
C4,3
C4,4
C2,1
C2,2
C1,1
SF = 8
SF = 4
SF = 2
SF = 1
Prior Art
Code-tree

FIG. 1

FIG. 2


201
211
to mobile station
212
from mobile station
Transmitter
215
206
Controller
(code partitioning)
205
204
Receiver
210

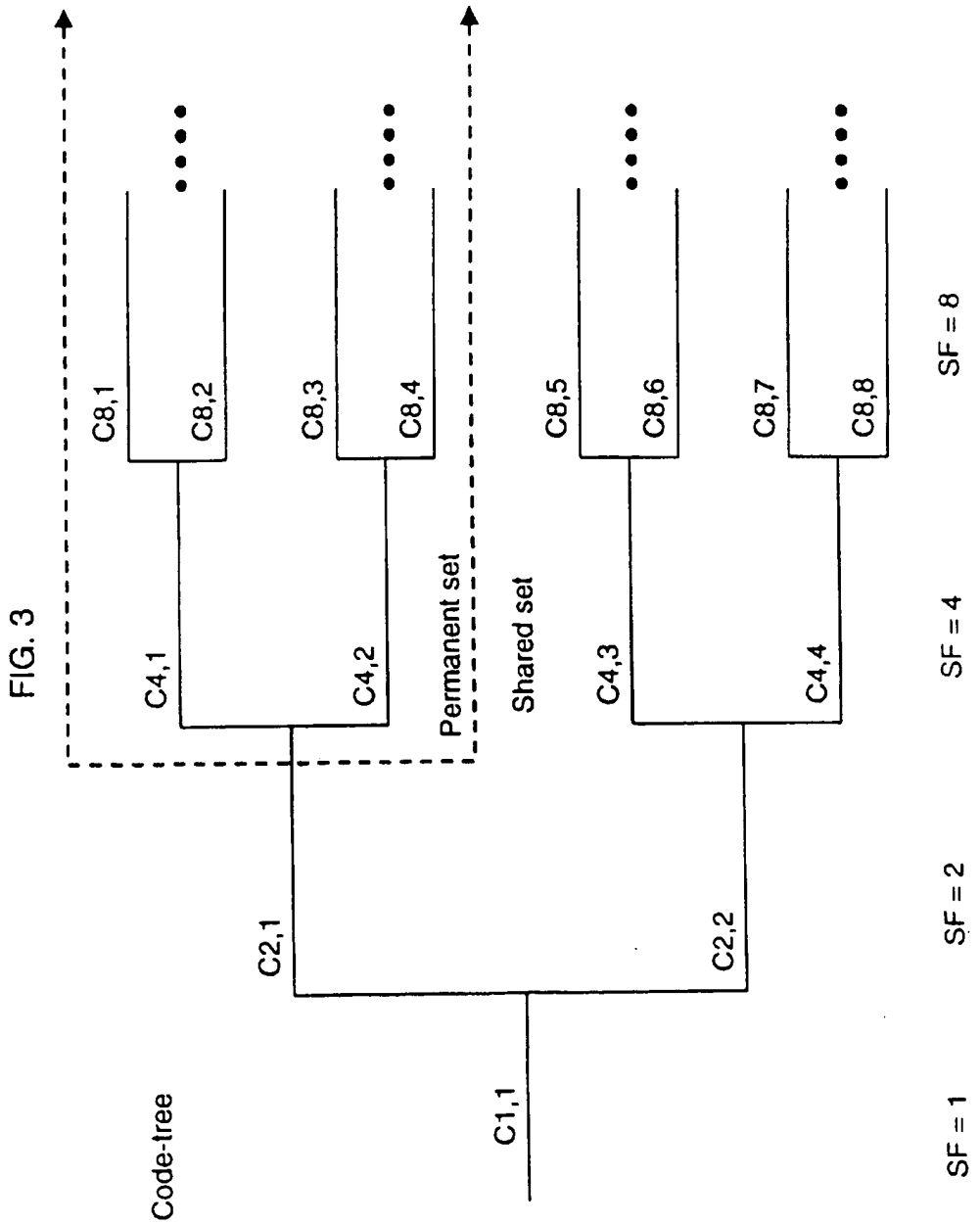
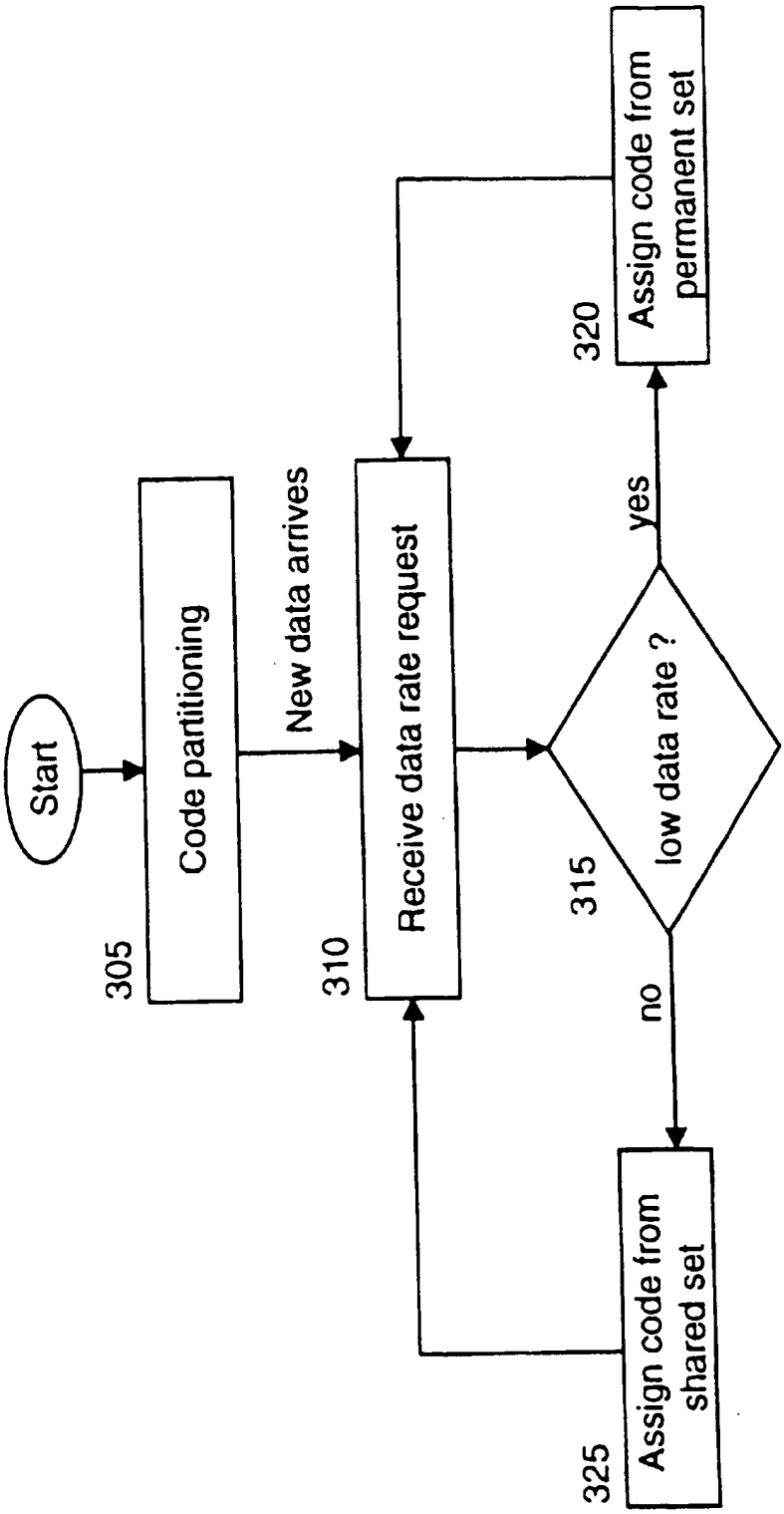

C8,1
C8,2
C8,3
C8,4
C8,5
C8,6
C8,7
C8,8
C4,1
C4,2
C4,3
C4,4
C2,1
C2,2
C1,1
Permanent set
Shared set
Code-tree
SF = 8
SF = 4
SF = 2
SF = 1

FIG. 3

FIG. 4


Start
Code partitioning
305
New data arrives
Receive data rate request
310
low data rate ?
315
yes
Assign code from permanent set
320
no
Assign code from shared set
325

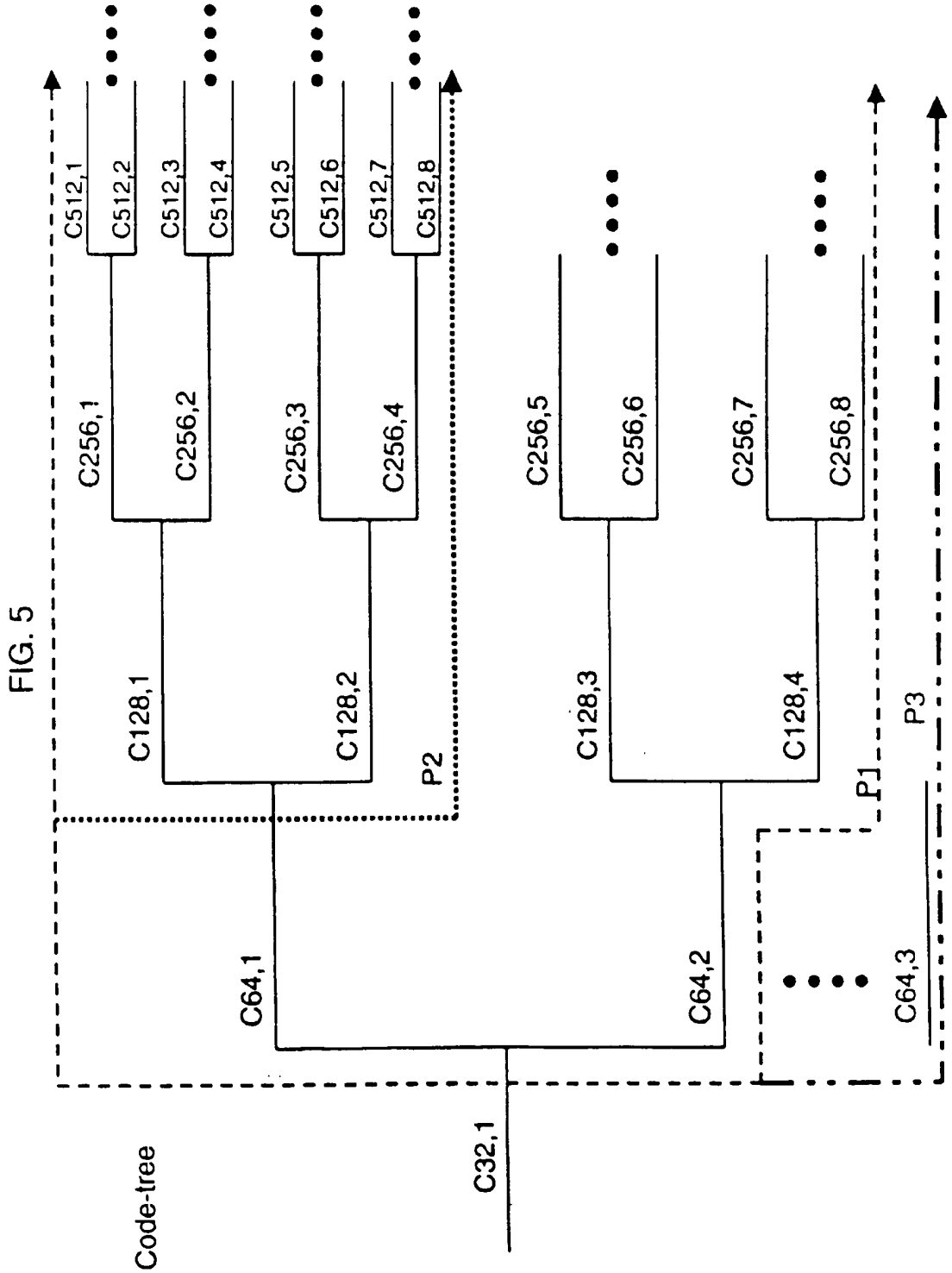

C512,1
C512,2
C512,3
C512,4
C512,5
C512,6
C512,7
C512,8
C256,1
C256,2
C256,3
C256,4
C256,5
C256,6
C256,7
C256,8
C128,1
C128,2
C128,3
C128,4
C64,1
C64,2
C64,3
C32,1
P1
P2
P3
Code-tree

FIG. 5

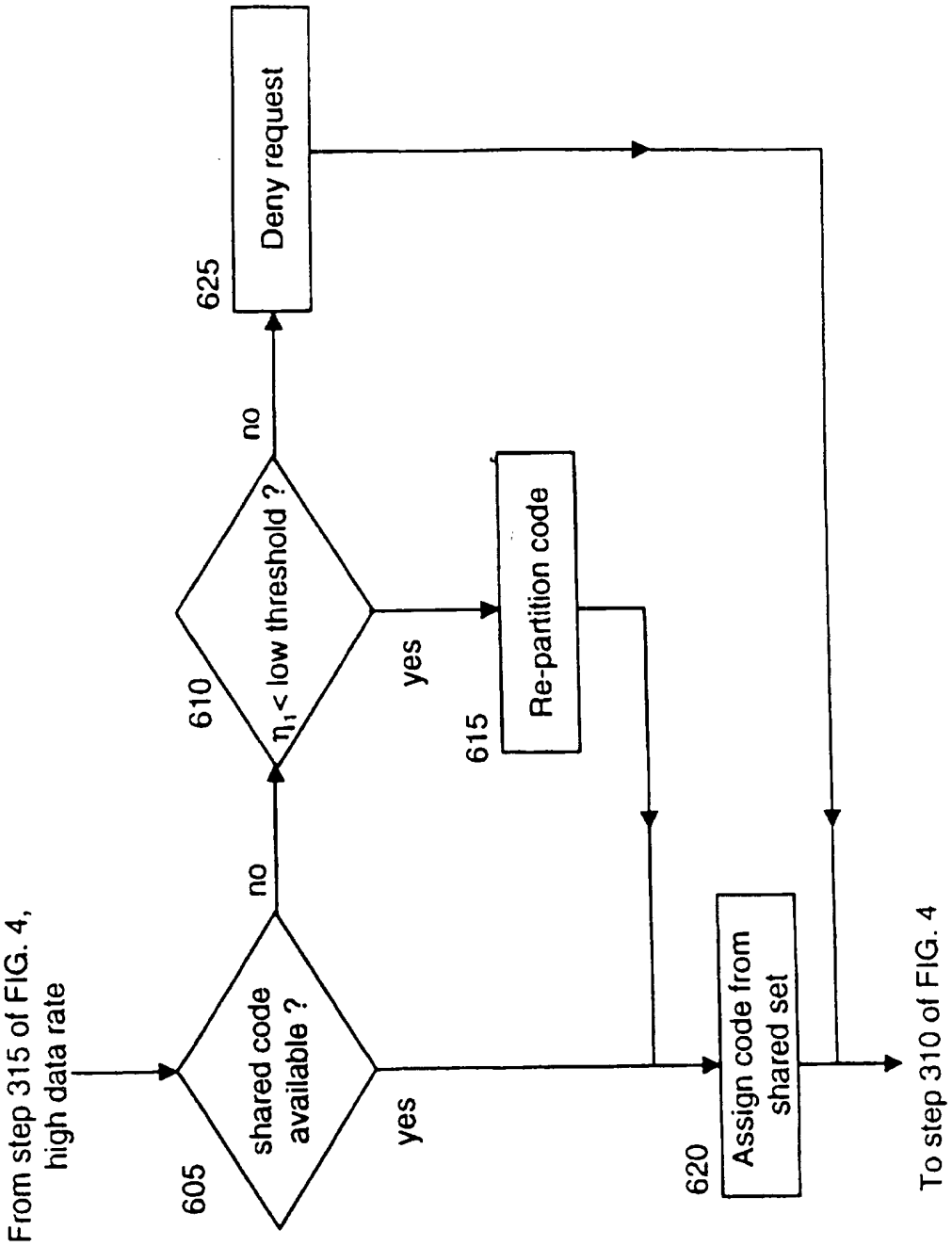

From step 315 of FIG. 4, high data rate
605
shared code available ?
no
yes
610
η_1 < low threshold ?
no
yes
615
Re-partition code
620
Assign code from shared set
625
Deny request
To step 310 of FIG. 4

FIG. 6

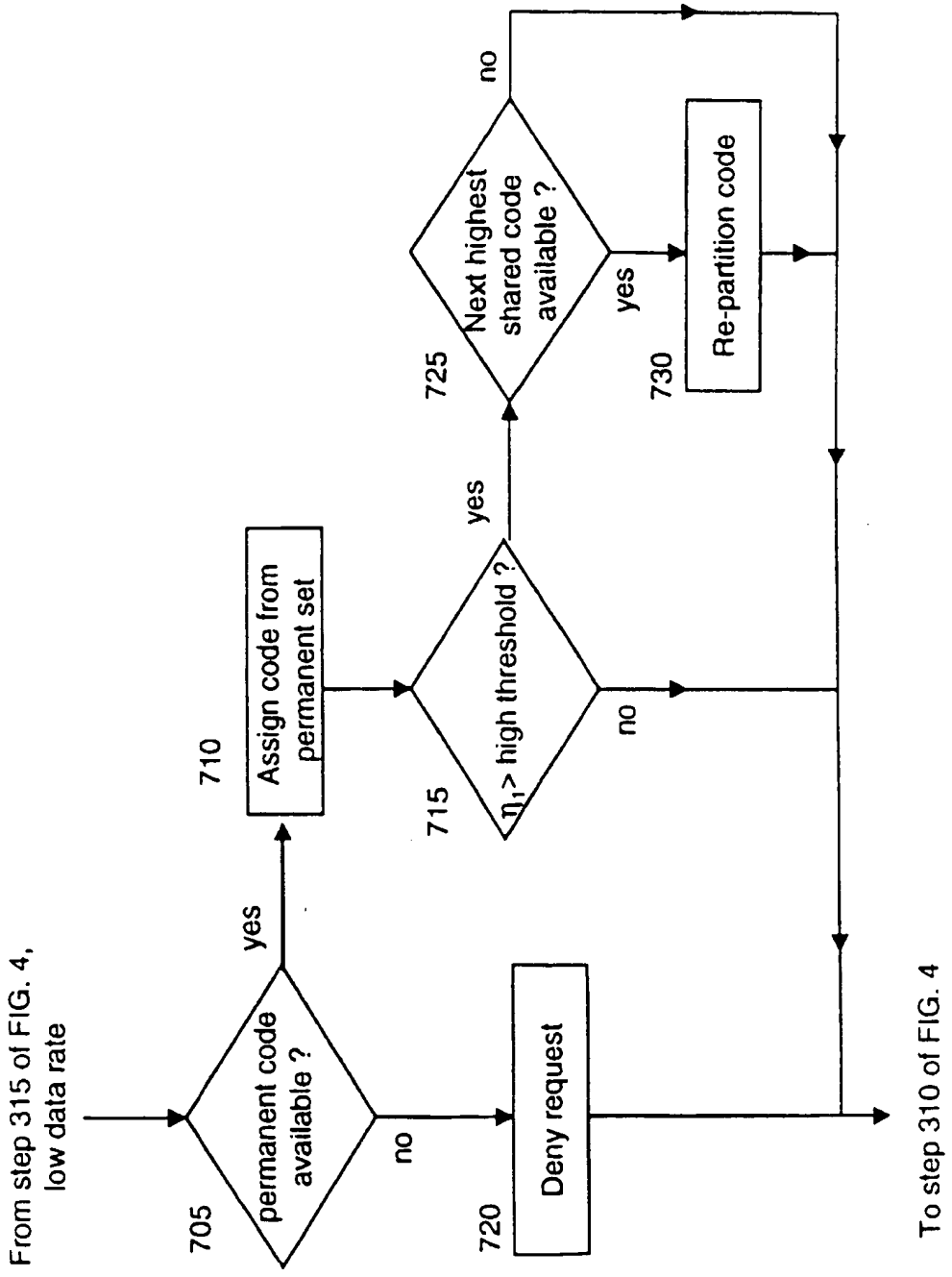

From step 315 of FIG. 4, low data rate
705
permanent code available ?
yes
no
710
Assign code from permanent set
715
η_1 > high threshold ?
yes
no
725
Next highest shared code available ?
yes
no
730
Re-partition code
720
Deny request
To step 310 of FIG. 4

FIG. 7

DYNAMIC CODE ALLOCATION FOR DOWNLINK SHARED CHANNELS

FIELD OF THE INVENTION

This invention relates generally to communications and, more particularly, to wireless communications systems.

BACKGROUND OF THE INVENTION

With the urge to provide multimedia capabilities in mobile communications, there is an increasing need for providing higher bandwidth in a wireless access network. Thus, multi-rate and variable rate services are considered very important features in future wireless systems such as the Universal Mobile Telecommunications System (UMTS) (e.g., see E. Dahlman et al, *"UMTS/IMT 2000 Based On Wideband CDMA,"* IEEE Communications Magazine, September 1998, pp 70–80). In proposed UMTS-based Terrestrial Radio Access (UTRA) FDD (frequency division duplex) systems, different data rates are achieved by using, what is known in the art as, channelization codes with different spreading factors. (As used herein, the term "data rate" applies to any multi-media application that requires packet transport, e.g., a voice packet is transmitted with a particular data rate.)

Channelization codes in UMTS are Orthogonal Variable Spreading Factor (OVSF) codes that preserve the orthogonality between downlink channels of different data rates and spreading factors within a cell. (As known in the art, in wireless communications a geographical region is divided into cells (typically of a hexagonal pattern).) The OVSF codes (hereafter simply referred to as codes) are defined using a code-tree, a portion of which is shown in FIG. **1**. As shown in FIG. **1**, a particular code is represented as Ci,j, where the subscript i,j, identifies the length spreading factor (SF) and the number of the code, respectively. For example, **C2,1** is the first code with a length SF of 2. As such, it can be observed that each level of the code-tree defines a number of codes having a particular length SF. In the context of FIG. **1**, for an illustrative chip rate of 4.096 Mcps (millions of chips per second), a mobile data user (user) requiring a data rate of 512 Kbps (thousands of bits per second) will use a code with a spreading factor of 8 (either one of **C8,1** through **C8,8**) while a 64 Kbps user uses a code (further down the tree) with a spreading factor of 64 (either one of **C64,1** through **C64,64**) (not shown).

Unfortunately, all codes within the code-tree cannot be used simultaneously within a cell. In particular, a code can be used in a cell if and only if no other code on the path from the specific code to the root of the tree or in the sub-tree below the specific code is used in the same cell. For example, with reference to FIG. **1**, if the code **C4,3** is used, then the codes **C1,1**, **C2,2**, and all codes corresponding to the children of the node representing the code, **C4,3**, cannot be used. Thus, the number of available codes depends on how the codes are assigned to each user.

The downlink shared channel (DSCH) concept (e.g., see Tdoc SMG2 UMTS-L1 311/98, *"UTRA FDD Downlink Packet Data Operation with Shared Channels"*, Nokia) is an attempt to remedy this potential code shortage problem. In DSCH, all codes are shareable, or multiplexed, between users on a frame by frame basis, thus achieving the highest possible multiplexing gain.

In particular, DSCH is a type of transport channel shared by a number of users for data rate transmissions in which the generated traffic is usually bursty and delay insensitive (such as results from web browsing). As such, DSCH only carries data traffic from high-rate users. A user is assigned a temporary code for the DSCH. The assigned code is on a frame-by-frame basis. A user therefore uses the assigned code for at least a full 10 ms (milli-second) frame. Each user who will share the DSCH is assigned a dedicated downlink traffic channel. (This dedicated traffic channel carries Layer **1** information such as pilot, power control bits (TPC) and transport-format combination indicator (TFCI) bits. This channel can also carry higher layer (Layer **2/3**) signaling.)

SUMMARY OF THE INVENTION

However, we have observed that the above-described code sharing method generates additional Layer **1**, **2**, and **3** signaling since the code assignments may need to be reshuffled to admit new users. For example, as noted above, the code assigned to a low data rate user eliminates possible assignments of any code on the path back to the root of the code-tree (these are codes with lower length SFs than the assigned code). As such, in order to free up a code (with a lower length SF) for use by a high data rate user, a low rate user may have to be reassigned another code.

Therefore, and in accordance with the invention, a code-tree is partitioned into two parts, or sets: a permanent set and a shared set.

In an embodiment of the invention, a code-tree is partitioned into two sets: a permanent set and a shared set. Those codes in the permanent set are assigned to a user for the duration of a session, or connection. Those codes in the shared set are assigned to users on a frame-by-frame basis using the above-mentioned DSCH channel. Typically, users with low data rate requests (e.g., voice) are assigned codes from the permanent set, and users with high data rate requests are assigned codes from the shared set.

In another embodiment of the invention, the partition boundary between the permanent set and the shared set is dynamically shifted based on traffic conditions.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** shows a portion of a prior art code-tree;

FIG. **2** shows a portion of a wireless endpoint embodying the principles of the invention;

FIG. **3** shows a portion of a code-tree in accordance with the principles of the invention;

FIG. **4** is a flow chart of an illustrative method in accordance with the principles of the invention;

FIG. **5** illustrates dynamic partitioning of a code-tree; and

FIGS. **6** and **7** are flow charts of illustrative methods for dynamically partitioning a code-tree.

DETAILED DESCRIPTION

In accordance with the inventive concept, a wireless endpoint, e.g., a base station, partitions a code-tree into a permanent set and a shared set. FIG. **2** shows a portion of a base station **201** embodying the principles of the invention. Except as noted below, it is assumed that base station **201** conforms to currently proposed UMTS standards, e.g., as cited above. Other than the inventive concept, the elements shown in FIG. **2** are well-known and will not be described in detail. For example, controller **205** is representative of a stored-program-controlled processor with associated memory as known in the art. Also, only that portion of base station **201** related to the inventive concept is shown, e.g., other processing by receiver **210** of the received signal is not

described. Base station **201** comprises controller **205** (also referred to herein as the base station processor), receiver **210**, and transmitter **215**. Receiver **210** receives an uplink signal, **212**, from a mobile station (not shown) and provides information from the uplink signal to controller **205** via signal(s) **204**. Controller **205** provides downlink information via signal(s) **206** to transmitter **215** for transmission to the mobile station (not shown) via downlink signal **211**.

As noted above, each base station uses codes from a code-tree to preserve the orthogonality between downlink channels of different data rates and spreading factors within a cell. (The code-tree is assumed to be stored within the above-mentioned memory (not shown) of controller **205**). In accordance with the invention, base station **201** partitions the code-tree into two sets: a permanent set and a shared set. This code partitioning is illustrated in FIG. **3**, which shows a portion of a code-tree. As can be seen in FIG. **3**, the permanent set comprises all codes in the subtree below the code C**2**,**1**, e.g., C**4**,**1**, C**4**,**2**, C**8**,**1**, C**8**,**2**, C**8**,**3**, C**8**,**4**, etc. All other codes are in the shared set, e.g., C**2**,**2**. C**4**,**3**, C**8**,**5**, etc.

Reference now should also be made to FIG. **4**, which shows a flow chart of an illustrative method in accordance with the principles of the invention. It is presumed that the base station processor is suitably programmed to carry out the below-described method using conventional programming techniques, which, as such, will not be described herein. In step **305**, the base station processor partitions the code into a permanent set and a shared set. This code partitioning can either be performed a priori or dynamically (described further below).

In step **310**, the base station processor receives a data request from a mobile station (not shown) via the above-mentioned uplink channel, e.g., **212**. In step **315**, the base station processor determines if the data rate request is a low data rate request or not (e.g., alternatively a high data rate request). (As observer earlier, a data rate request includes, e.g., a request for transmission of voice.) Illustratively, a low data rate request is defined as less than or equal to 32 Kbps. If it is a low data rate request, a code from the permanent set is assigned to the user for the duration of the session, or connection, in step **320**. If it is not a low data rate request, a code from the shared set is assigned in step **325**. Those codes in the shared set are assigned to users on a frame-by-frame basis using the above-mentioned DSCH channel. After the assignment of the code in either step **320** or step **325**, the base station processor returns to step **310** for processing additional data requests. (For simplicity, the following steps were not shown in the flow chart of FIG. **4**. If no more codes are available for assignment in either step **320** or step **325**, the user's request is denied. In this instance, it is up to the user to resubmit the request. Alternatively, the user's request is queued, or buffered, for reconsideration at the next decision point, e.g., the next frame. In this case, the user's request is not initially denied, but simply delayed. Also, once either the session, or connection, is terminated (in the case of a permanently assigned code) or the number of frames allocated to the mobile station (not shown) for use of the assigned shared code have been sent, the codes are released for reassignment.)

For example, when a request for 8 Kbps (voice service, denoted as Request **1**) arrives, the base station processor assigns a code with a spreading factor of 512 (corresponding to 8 Kbps) from the permanent set (not shown in FIG. **3**). When a request for 64 Kbps arrives (denoted as Request **2**), the base station processor assigns a code with a spreading factor of 64 from the shared set (not shown in FIG. **3**). This code from the shared set is allocated on a frame-by-frame basis in accordance with the above-mentioned DSCH channel. Illustratively, assume that code C**64**,**33** is available for assignment from the shared set and is assigned by the base station processor to Request **2** for the duration of four frames. This means that C**2**,**2**, C**4**,**3**, C**8**,**5**, C**16**,**9**, C**32**,**17** and all codes below the subtree of C**64**,**33** are not available for other users, i.e., they are blocked codes. Once the request is satisfied, code C**64**,**33** is released and is available for re-assignment (and this will also release the above-mentioned blocked codes for subsequent assignment).

It should also be noted that codes from the permanent set are shared between providing a DCH (data channel) for low data rate users as well as signaling channels for DSCH users. For example, the base station processor assigns a code with a spreading factor of 512 from the permanent set for signaling purposes with the mobile stations (not shown).

As noted above, the code partitioning can be performed dynamically. For example, the partition boundary between the permanent set and the shared set can be dynamically shifted, or moved, based on traffic conditions. This is illustrated in FIG. **5**. As shown in FIG. **5** a code-tree is initially partitioned so that the permanent set corresponds to set P**1**, which comprises all codes in the subtree below the code C**32**,**1**, e.g., C**64**,**1**, C**64**,**2**, C**8**,**1**, C**128**,**1**, C**128**,**2**, C**128**,**3**, etc. All other codes are in the shared set, e.g., C**64**,**3**, etc. For this example, a low data rate is defined as less than or equal to 32 Kbps. (That is, users requesting data rates of 32 Kbps are assigned codes from the permanent set, P**1**.) Any users requesting higher data rates are assigned codes from the shared set. In this context, the above-described method of FIG. **4** is used except as modified by the methods shown in FIGS. **6** and **7** for dynamically partitioning the code-tree (described below). New users assigned codes from the permanent set are assigned codes as adjacent as possible. For example, first code C**512**,**1** is assigned, then code C**512**, **2**, then code C**512**, **3**, etc.

At this point, reference should be made to FIG. **6**, which shows a flow chart for an illustrative threshold-based method for changing the boundary between the permanent set and the shared set. From the original partition, P**1**, it can be observed that it is possible to accommodate 16 "low data rate" users at 8 Kbps each (e.g., C**512**, **1** through C**512**, **8**, and C**512**,**9** through C**512**,**16** (this latter group is not shown in FIG. **5** but extends from C**256**, **5** through C**256**,**8**). Let a variable, η_1, be defined as representing the utilization percentage of the permanent set determined in the context of admitted 8 Kbps users. That is,

$$\eta_1 = \frac{\text{number of admitted 8 Kbps users}}{\text{maximum number of 8 Kbps users}} \times 100.$$

As noted, in this example, the maximum number of 8 Kbps users is 16. For every low data rate user admitted to the system, the equivalent number of 8 Kbps users is determined and the value of η_1 is updated to reflect the new utilization value. For example, if a new user requesting 16 Kbps arrives and is admitted to the system, this user's equivalent 8 Kbps utilization is equal to (16 Kbps/8 Kbps)=2. As such, the number of admitted 8 Kbps users is increased by 2 and the utilization percentage of the permanent set, η_1, is updated to reflect the new utilization value.

After the base station processor determines that a high data rate user is requesting access (e.g., see step **315** of FIG. **4**), a check is made in step **605** to determine if a shared code is available for assignment. If a shared code is available for assignment, the shared code is assigned in step **620** and

execution returns to step **310** of FIG. **4**. However, if no shared code is available, the current value of η_1 is compared to a predetermined low threshold, e.g., 40% in step **610**. If η_1<low threshold, the partition boundary is changed in step **615**, and as illustrated in FIG. **5** by reducing the permanent partition from P1 to P2. This re-partitioning makes code C64,2 available for the requesting high data rate user. (As noted above, if the permanent set codes are assigned, e.g., sequentially and adjacency is maintained, a utilization percentage of 40% ensures the assigned codes are limited to the paths ending in C512,1 through C512,8.) In step **620**, a code is assigned from the new shared set and execution returns to step **310** of FIG. **4**. On the other hand, if $\eta_1 \geqq$low threshold, in step **610**, then the requesting high data rate user is not admitted in step **625** and execution returns to step **310** of FIG. **4**.

Conversely, a method for use in enlarging the permanent set is shown in FIG. **7**. After the base station processor determines that a low data rate user is requesting access (e.g., see step **315** of FIG. **4**), a check is made in step **705** to determine if a permanent code is available for assignment. If a permanent code is not available for assignment, the request is denied in step **720** and execution returns to step **310** of FIG. **4**. However, if a permanent code is available for assignment, the permanent code is assigned in step **710**. At this point, the value of ill is adjusted and the adjusted value is compared to a predetermined high threshold, e.g., 75% in step **715**. If $\eta_1 \leqq$high threshold, then execution returns to step **310** of FIG. **4**. However, if η_1>high threshold, a check is made in step **725** if the next highest shared code is available, i.e., not blocked. If the next highest shared code is blocked, execution returns to step **310** of FIG. **4**. If the next highest shared code is not blocked, the partition boundary is changed in step **730**, and as illustrated in FIG. **5** by enlarging the permanent partition from P1 to P3. In the context of FIG. **5**, this makes additional codes under C64,3 available for low data rate users. In this example, once the number of available permanent codes exceeds a threshold and if adjacent shared codes are not blocked, the permanent set is expanded (at the expense of the shared set) to accommodate more low data rate users.

Other modifications to the notion of dynamic partitioning may be made. For example, an equivalent utilization factor for the shared set can be defined and a method similar to that shown in FIG. **6** used for enlarging the permanent set when the shared set has an efficiency lower than a threshold value. (Again, it would be assumed that code assignments in the shared set would be as adjacent as possible but from the opposite end of the tree, e.g., referring briefly to the partition illustrated in FIG. **3**, the shared code assignments would start from, e.g., C4,4.) Similarly, the base station can periodically monitor the efficiencies of either the shared set and/or the permanent set and, when the respective efficiencies are less than a threshold (predefined or changed in real time) re-partition the code-tree.

The foregoing merely illustrates the principles of the invention and it will thus be appreciated that those skilled in the art will be able to devise numerous alternative arrangements which, although not explicitly described herein, embody the principles of the invention and are within its spirit and scope. For example, although the inventive concept was illustrated herein as being implemented with discrete functional building blocks, e.g., a controller, etc., the functions of any one or more of those building blocks can be carried out using one or more appropriately programmed processors, e.g., a digital signal processor; discrete circuit elements; integrated circuits; etc. Further, although illustrated in the context of UMTS, the inventive concept is applicable to any wireless system or application that requires allocation of codes. Similarly, although the invention was illustrated in the context of base station, the invention is applicable to any wireless endpoint, e.g., a mobile station.

What is claimed:

1. A method for use in a wireless endpoint, the method comprising the steps of:

partitioning a code-tree into a permanent set and a shared set;

communicating with another wireless endpoint by first selecting either the permanent set or the shared set and then selecting a code, from the selected set, for use in transporting data to the other wireless endpoint; and

re-partitioning the code-tree as a function of traffic.

2. The method of claim **1** wherein the code tree represents a number of channelization codes.

3. The method of claim **2** wherein the channelization codes are orthogonal variable spreading factor codes.

4. The method of claim **1** wherein the communicating step includes the steps of:

selecting the permanent set when the other wireless endpoint requests a data rate below a threshold; and

selecting the shared set otherwise.

5. The method of claim **1** wherein a code selected from the shared set is assigned on a frame-by-frame basis to the other wireless endpoint, while a code selected from the permanent set is assigned to the other wireless endpoint for the duration of a data session with the other wireless endpoint.

6. A method for use in a wireless endpoint, the method comprising the steps of:

receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate; and

selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session, said selecting a code step including the step of re-partitioning the code-tree as a function of traffic.

7. The method of claim **6** wherein the code tree represents a number of channelization codes.

8. The method of claim **7** wherein the channelization codes are orthogonal variable spreading factor codes.

9. The method of claim **6** wherein a code selected from the shared set is assigned on the frame-by-frame basis using a downlink shared channel (DSCH).

10. The method of claim **6**, wherein the step of selecting either the shared set or the permanent set includes the steps of:

selecting the permanent set if the associated data rate is less than a threshold; and

selecting the shared set otherwise.

11. A method for use in a wireless endpoint, the method comprising the steps of:

receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate,

wherein if the shared set is selected, determining if a shared code is available for assignment;

if a shared code is not available for assignment, re-partitioning the code-tree if a utilization factor of the permanent set is less than a utilization threshold value, wherein the re-partitioning results in increasing the size of the shared set; and

selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session.

12. A method for use in a wireless endpoint, the method comprising the steps of:

receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate, wherein if the permanent set is selected, determining if a permanent code is available for assignment;

if a permanent code is not available for assignment, re-partitioning the code-tree if a utilization factor of the shared set is less than a utilization threshold value, wherein the re-partitioning results in increasing the size of the permanent set; and

selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session.

13. A method for use in a wireless endpoint, the method comprising the steps of:

receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate, wherein if the permanent set is selected, determining a utilization factor of the permanent set;

if the utilization factor is greater than a threshold, re-partitioning the code-tree to increase the size of the permanent set; and

selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session.

14. The method of claim **13** wherein the determining step includes the step of determining the utilization factor subsequent to the assignment of a permanent code to the other wireless endpoint.

15. A method for use in a wireless endpoint, the method comprising the steps of:

receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate wherein if the shared set is selected, determining a utilization factor of the shared set;

if the utilization factor is greater than a threshold, re-partitioning the code-tree to increase the size of the shared set; and

selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session.

16. The method of claim **15** wherein determining step includes the step of determining the utilization factor subsequent to the assignment of a shared code to the other wireless endpoint.

17. A wireless endpoint comprising:

a receiver for receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

a processor for (a) selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate, (b) selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session, and (c) the processor re-partitions the code-tree as a function of traffic.

18. The wireless endpoint of claim **17** wherein the code tree represents a number of channelization codes.

19. The wireless endpoint of claim **18** wherein the channelization codes are orthogonal variable spreading factor codes.

20. The wireless endpoint of claim **17** wherein a code selected from the shared set is assigned on the frame-by-frame basis using a downlink shared channel (DSCH).

21. The wireless endpoint of claim **17**, wherein the processor selects the permanent set if the associated data rate is less than a threshold; and selects the shared set otherwise.

22. A method for use in a first wireless endpoint, the method comprising the steps of:

partitioning a code-tree into a permanent set and a shared set;

communicating with a second wireless endpoint by selecting the permanent set when the second wireless endpoint requests a data rate below a threshold and then selecting a code, from the permanent set, for use in transporting data to the second wireless endpoint; and

otherwise, selecting the shared set.

23. A method for use in a first wireless endpoint, the method comprising the steps of:

receiving a data request, from a second wireless endpoint, for a data session, the data request having an associated data rate;

selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate, wherein the permanent set is selected if the associated data rate is less than a threshold; and the shared set is selected otherwise; and

selecting a code from the selected set for use by the second wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the second wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the second wireless endpoint for a period of time less than the duration of the data session.

24. A wireless endpoint comprising:

a receiver for receiving a data request, from another wireless endpoint, for a data session, the data request having an associated data rate;

a processor for (a) selecting either a shared set of codes or a permanent set of codes as a function of the associated data rate, wherein the processor selects the permanent set if the associated data rate is less than a threshold, and selects the shared set otherwise; and (b) selecting a code from the selected set for use by the other wireless endpoint, wherein, if the code is selected from the permanent set, the code is assigned to the other wireless endpoint for the duration of the data session, and if the code is selected from the shared set, the code is assigned to the other wireless endpoint for a period of time less than the duration of the data session.

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